June 1998

Science 30

Grade 12 Diploma Examination

Alberta
EDUCATION

June 1998

Science 30

Grade 12 Diploma Examination

Description

Time: 2.5 h. You may take an additional 0.5 h to complete the examination.

This is a **closed-book** examination consisting of

- 44 multiple-choice and 12 numerical-response questions of equal value, worth 70% of the examination
- 2 written-response questions, each worth 15% of the examination

This examination contains sets of related questions.

A set of questions may contain multiple-choice and/or numerical-response and/or written-response questions.

A science data booklet is provided for your reference.

The perforated pages at the back of this booklet may be torn out and used for your rough work. No marks will be given for work done on the tear-out pages.

Instructions

- Fill in the information required on the answer sheet and the examination booklet as directed by the presiding examiner.
- You are expected to provide your own scientific calculator.
- Use only an HB pencil for the machine-scored answer sheet.
- If you wish to change an answer, erase **all** traces of your first answer.
- Consider all numbers used in the examination to be the result of a measurement or observation.
- Do not fold the answer sheet.
- The presiding examiner will collect your answer sheet and examination booklet and send them to Alberta Education.
- Read each question carefully.
- Now turn this page and read the detailed instructions for answering machine-scored and written-response questions.

Multiple Choice

- Decide which of the choices **best** completes the statement or answers the question.
- Locate that question number on the separate answer sheet provided and fill in the circle that corresponds to your choice.

Example

This examination is for the subject of

A. science
B. biology
C. physics
D. chemistry

Answer Sheet

● Ⓑ Ⓒ Ⓓ

Numerical Response

- Record your answer on the answer sheet provided by writing it in the boxes and then filling in the corresponding circles.
- If an answer is a value between 0 and 1 (e.g., 0.25), then be sure to record the 0 before the decimal place.
- **Enter the first digit of your answer in the left-hand box and leave any unused boxes blank.**

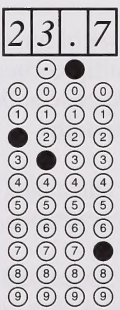
Examples

Calculation Question and Solution

The average of the values 21.0, 25.5, and 24.5 is _____.
(Record your answer to three digits on the answer sheet.)

Average = (21.0 + 25.5 + 24.5)/3
= 23.666
= 23.7 (rounded to three digits)

Record 23.7 on the answer sheet →



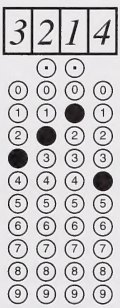
Correct-Order Question and Solution

When the following subjects are arranged in alphabetical order, the order is _____. (Record all four digits on the answer sheet.)

1 physics
2 chemistry
3 biology
4 science

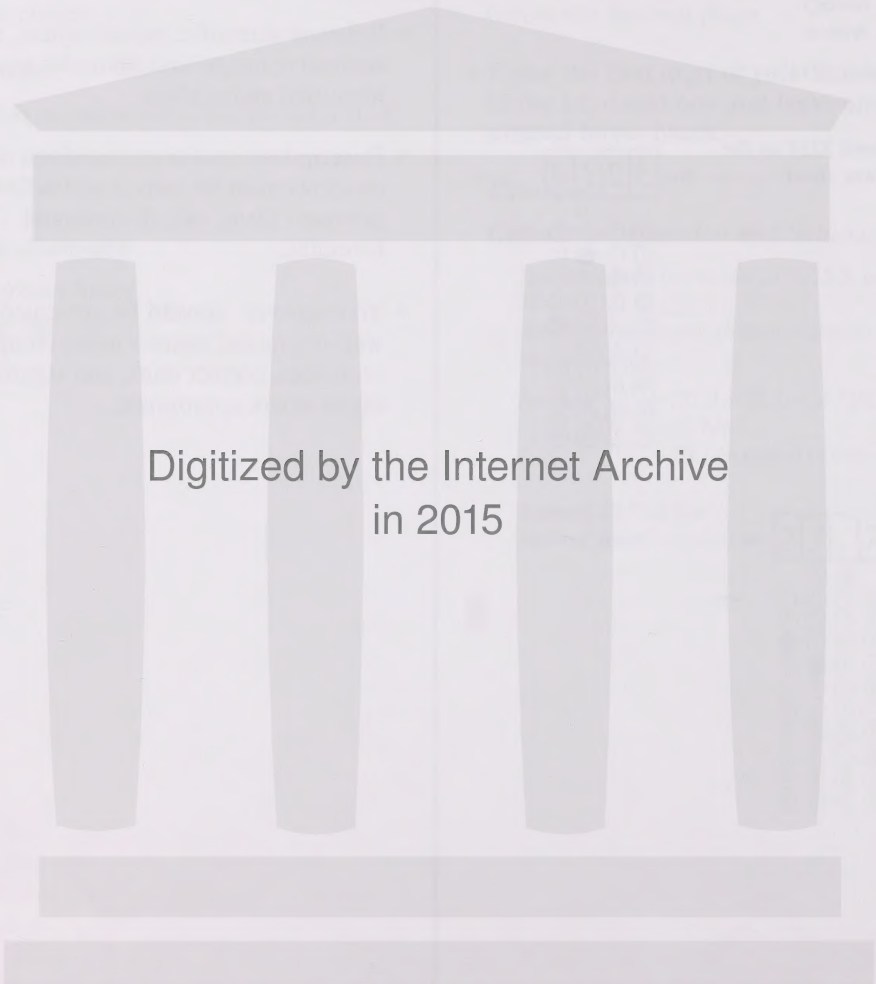
Answer 3214

Record 3214 on the answer sheet →



Written Response

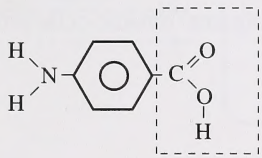
- Write your answers in the examination booklet as neatly as possible.
- For full marks, your answers must be well organized and address **all** the main points of the question.
- Relevant scientific, technological, and/or societal concepts and examples must be identified and explicit.
- Descriptions and/or explanations of concepts must be correct and reflect pertinent ideas, calculations, and formulas.
- Your answers **should be** presented in a well-organized manner using complete sentences, correct units, and significant digits where appropriate.



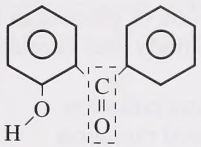
Participants in a triathlon compete in swimming, cycling, and running.

Use the following information to answer the next question.

Structural Formulas for Two Common Sunscreen Components



I



II

1. The athletes are advised to apply a sunscreen to exposed skin. The functional groups present in compounds I and II are, respectively,

A. a ketone and an alcohol
B. an aldehyde and an alcohol
C. a carboxylic acid and a ketone
D. a carboxylic acid and an aldehyde

---

2. Sunscreen lotions provide protection by blocking

A. visible light
B. microwaves
C. infrared radiation
D. ultraviolet radiation

3. The DNA in an athlete's skin cells may mutate after prolonged exposure to the sun. The process that will pass the mutation along to daughter cells is

A. mitosis, and the mutation will be inherited by children of the athlete
B. meiosis, and the mutation will be inherited by children of the athlete
C. mitosis, and the mutation will not be inherited by children of the athlete
D. meiosis, and the mutation will not be inherited by children of the athlete

4. At the end of a triathlon, the resting heart rate of the participants is restored by stimulation of the

   A. sympathetic nervous system, which causes the heart to beat faster
   B. sympathetic nervous system, which causes the heart to beat slower
   C. parasympathetic nervous system, which causes the heart to beat faster
   D. parasympathetic nervous system, which causes the heart to beat slower

5. The oxidation of glucose in the participants' muscle cells produces a large amount of heat. This body heat is released as

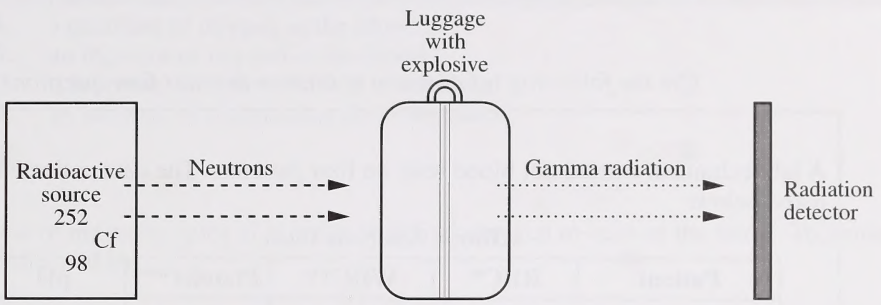
   A. gamma radiation
   B. infrared radiation
   C. ultraviolet radiation
   D. microwave radiation

6. The combustion of hydrogen fuel in a race official's vehicle used in the cycling event and the oxidation of glucose in the participants' bodies are similar in that both processes

   A. require oxygen
   B. produce carbon dioxide
   C. reduce the greenhouse effect
   D. contribute to ozone depletion

Use the following information to answer the next two questions.

Airports use a radioactive source to detect explosive devices in luggage.



7. A participant had her luggage checked as she prepared to go home after a triathlon. The reaction in the radioactive source is represented by the equation

$$^{252}_{98}\text{Cf} \rightarrow {}^{251}_{98}\text{Cf} + {}^{1}_{0}\text{n} + \text{energy}.$$

This reaction is an example of

A. nuclear fusion
B. a physical change
C. a chemical change
D. an exothermic change

Numerical Response

1. Many explosive devices contain an isotope of nitrogen (N) that reacts with neutrons to form $^{15}_{7}\text{N}$ and gamma rays. The reaction for the explosive device in the luggage can be represented by

$$^{a}_{0}\text{n} + {}^{b}_{c}\text{N} \rightarrow {}^{15}_{7}\text{N} + \text{gamma radiation}.$$

Give the values of ***a***, ***b***, and ***c*** in the equation above.

a _____ (Record the value of ***a*** in the **first** column on the answer sheet.)

b _____ _____ (Record the value of ***b*** in the **second and third** columns on the answer sheet.)

c _____ (Record the value of ***c*** in the **fourth** column on the answer sheet.)

The principles of science and technology are applied during medical care.

Use the following information to answer the next four questions.

A lab technician carried out blood tests on four patients. The data collected are listed below.

Blood Analysis Data

Patient	RBC*	WBC**	Platelet***	pH
Mark	6 000	7	300	7.42
Ashley	4 700	7	300	7.34
Lee	5 100	15	300	7.29
Pat	5 000	6	100	7.40
Normal values	*5 100*	*7*	*300*	*7.34 – 7.44*

*Red blood cell count $\times 10^3/mm^3$

**White blood cell count $\times 10^3/mm^3$

***Platelet count $\times 10^3/mm^3$

8. According to these data, Ashley would experience the greatest difficulty in

A. running a long race
B. controlling bleeding
C. fighting a cold virus
D. digesting a large meal

9. The patient who would have the slowest rate of blood clotting is

A. Mark
B. Ashley
C. Lee
D. Pat

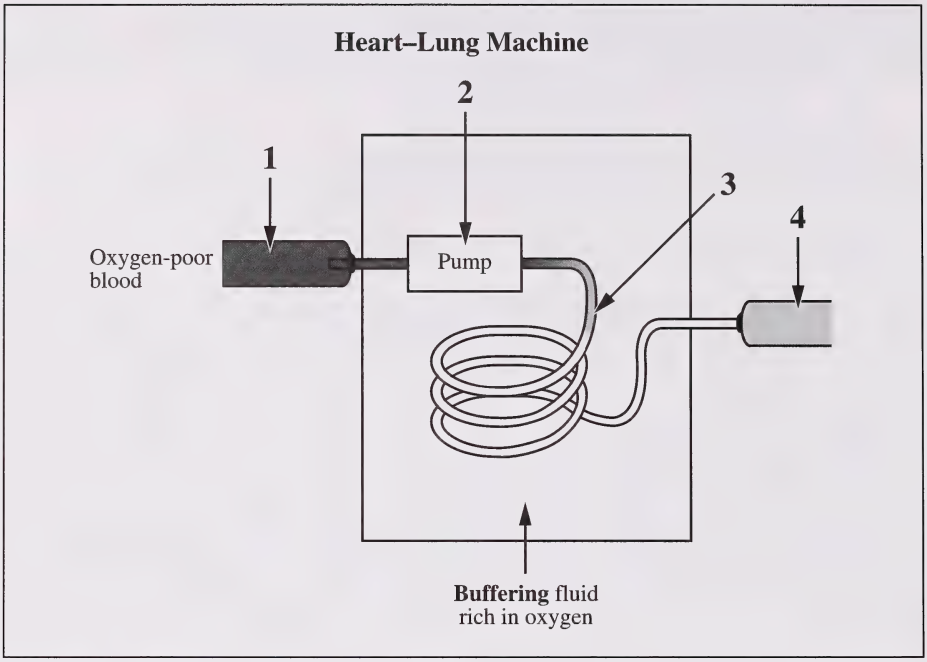
10. Lee is suffering from pneumonia. Pneumonia impedes gas exchange in the lungs, which causes changes in the pH of the blood. This change in the pH of Lee's blood can be attributed to

A. a decrease of oxygen in the blood
B. an increase of oxygen in the blood
C. a decrease of carbon dioxide in the blood
D. an increase of carbon dioxide in the blood

11. One of the many roles of blood is to deliver oxygen to cells of the body. This role is performed by

A. platelets
B. helper T cells
C. red blood cells
D. white blood cells

Use the following information to answer the next two questions.



Numerical Response

2. During a heart operation, the patient's blood may be routed through a heart–lung machine. Match each number in the diagram with the structure given below that performs the same function.

Heart _____ (Record your answer in the **first** column on the answer sheet.)

Lung capillaries _____ (Record your answer in the **second** column on the answer sheet.)

Vena cava _____ (Record your answer in the **third** column on the answer sheet.)

Aorta _____ (Record your answer in the **fourth** column on the answer sheet.)

12. The **fluid** that bathes tube 3 performs the same function as the

A. heart and $CO_{2(g)}$

B. lungs and $CO_{2(g)}$

C. heart and $HCO_3^-{}_{(aq)}$

D. lungs and $HCO_3^-{}_{(aq)}$

13. Heart surgeons often inject dyes into a patient's bloodstream to ensure that blood vessels are not leaking after an operation. The dye is detected by using X-rays. Compared with visible light, an X-ray has a

A. lower frequency and a longer wavelength
B. lower frequency and a shorter wavelength
C. higher frequency and a longer wavelength
D. higher frequency and a shorter wavelength

14. A backflow of blood in the heart chamber causes an abnormal swishing sound, known as a heart murmur. This condition results from a defective

A. vein
B. valve
C. artery
D. atrium

15. Stress can cause a temporary increase in blood pressure. To return blood pressure to normal, the body's response is to

A. increase the heart's cardiac output and dilate the arterioles and veins
B. decrease the heart's cardiac output and dilate the arterioles and veins
C. increase the heart's cardiac output and constrict the arterioles and veins
D. decrease the heart's cardiac output and constrict the arterioles and veins

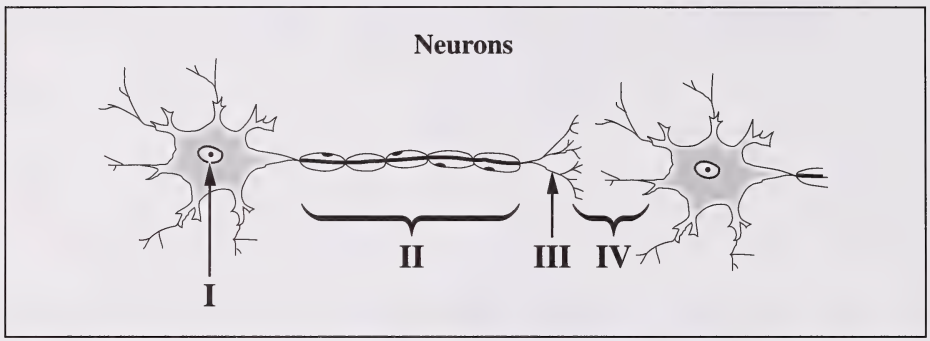
16. It is sometimes difficult to detect the virus responsible for an infection. To identify a virus, scientists analyze a protein manufactured by the B lymphocytes to combat the virus. This protein is called

A. a T cell
B. an antigen
C. an antibody
D. a macrophage

17. Terry has been taking antibiotics for strep throat (a bacterial infection) but is feeling better and does not want to take the remaining pills. Not finishing the prescription may

A. lead to a resistant strain of the bacteria
B. result in an overload on his immune system
C. interfere with the action of his helper T cells
D. cause his white blood cell count to jump to dangerous levels

Use the following information to answer the next two questions.



18. Doctors routinely test newborns for Babinski's reflex to determine if their nervous systems are completely myelinated. In the diagram above, myelin is found at location

A. I
B. II
C. III
D. IV

19. A normal action potential is transmitted in a neuron from

A. axon to cell body to synapse
B. axon to cell body to dendrite
C. dendrite to cell body to axon
D. dendrite to axon to cell body

20. A person suffers from an inherited condition known as retinitis pigmentosa. In its early stage, the condition causes a loss of night vision. This is due to deterioration of the

A. rod cells of the retina
B. cone cells of the retina
C. rod cells of the optic nerve
D. cone cells of the optic nerve

21. As light passes from air into eye tissues, the light rays bend. This phenomenon is known as

A. reflection
B. refraction
C. diffraction
D. polarization

Medical research often involves experiments on animals. Some of the results of these experiments can be applied to humans.

Use the following information to answer the next three questions.

Cyclodiene insecticides block the receptor that normally inhibits the firing of nerve cells. It is known that some fruit flies are resistant to cyclodienes. A research project included the following steps.

1. A sample of fruit flies was treated with cyclodiene insecticide.
2. Some flies survived, but most died.
3. A line of resistant flies was bred from the survivors.
4. The DNA of the resistant strain was compared with DNA from the non-resistant strain.

22. The purpose of this research was **most likely** to

A. breed resistant fruit flies
B. identify the resistance gene
C. test the cyclodiene insecticides
D. investigate the nervous system

Use the following additional information to answer the next question.

Before analyzing the DNA, the researchers conducted an experiment to make sure they had produced a strain of resistant fruit flies. This experiment included the following steps.

1. A sample of wild flies and a sample of the resistant strain of flies were treated with cyclodiene.
2. The percentage of flies surviving in each sample was calculated.

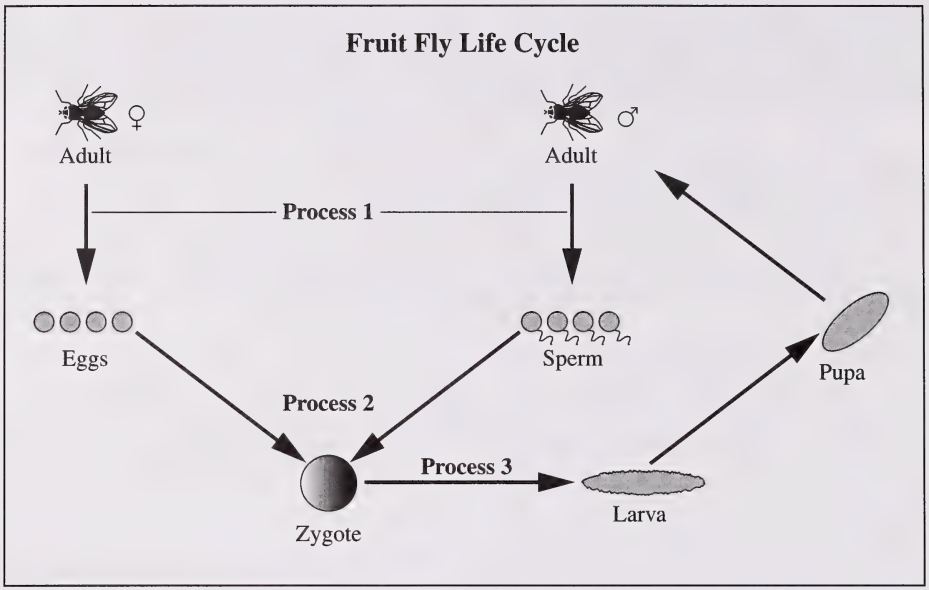
23. The responding variable in this experiment was the

A. total fly sample
B. resistant fly sample
C. application of cyclodiene
D. number of flies that survived

24. A cross between a homozygous resistant fly and a homozygous non-resistant fly is represented by RR $\times$ rr. If resistance to cyclodiene is due to a single dominant gene, the percentage of offspring that would be resistant from a cross between a homozygous resistant fly and homozygous non-resistant fly is

A. 25%
B. 50%
C. 75%
D. 100%

Use the following information to answer the next two questions.



Numerical Response

3. Match each process indicated in the diagram with its name.

Fertilization _____ (Record your answer in the **first** column on the answer sheet.)

Meiosis _____ (Record your answer in the **second** column on the answer sheet.)

Mitosis _____ (Record your answer in the **third** column on the answer sheet.)

25. The number of chromosomes is 2n (diploid) in the

A. egg and adult
B. sperm and larva
C. adult and zygote
D. sperm and zygote

Satellites have been launched to make observations from space and to study Earth and its atmosphere.

26. The gravitational force between a satellite and Earth depends upon the

A. size of the satellite and its orbital velocity
B. mass of the satellite and its orbital velocity
C. size of the satellite and its distance from Earth
D. mass of the satellite and its distance from Earth

Use the following information to answer the next question.

Objects

1 Brass weight
2 Glass rod and silk
3 Compass

Numerical Response

4. Magnetic, gravitational, and electric fields vary in different locations on Earth. Each of the common objects listed above can be used to demonstrate the presence of one of these fields. Match each of these common objects to the corresponding field. Use each number only **once**.

Magnetic field _____ (Record your answer in the **first** column on the answer sheet.)

Gravitational field _____ (Record your answer in the **second** column on the answer sheet.)

Electrical field _____ (Record your answer in the **third** column on the answer sheet.)

Numerical Response

5. In order to calculate the gravitational field strength at a point in space, scientists use the formula for acceleration due to gravity. The Hubble telescope orbits Earth at a distance of 6.98×10^6 m from Earth's centre. The gravitational field strength at the position of the Hubble spacecraft is _____ _•_ _____ _____ N/kg.

(Record your answer to **three digits** on the answer sheet.)

27. The **main** advantage of having a telescope in space, rather than on Earth's surface, is that placing it in space

A. decreases exposure to higher frequency EMR
B. decreases the distance from galaxies being studied
C. avoids absorption of some EMR by Earth's atmosphere
D. avoids reflection of light from clouds in the atmosphere

28. Helium was identified in the Sun's atmosphere thirty years before it was discovered on Earth. The instrument used to identify helium in the Sun's atmosphere was the

A. spectroscope
B. reflecting telescope
C. refracting telescope
D. electron microscope

Use the following information to answer the next question.

Radiation From Stars

1 Ultraviolet
2 X-rays
3 Gamma rays
4 Infrared

Numerical Response

6. The predominant radiation emitted by distant stars is an indication of their relative temperature. List, in order, the predominant radiation emitted from **hottest to coolest** stars.

Answer: _____ _____ _____ _____
hottest **coolest**

(Record your **four-digit** answer on the answer sheet.)

29. Spectroscopic analysis indicates that stars and galaxies are moving away from Earth. This movement produces red shift. Red shift is an example of the

A. Doppler effect, and it supports the Big Bang Theory
B. Doppler effect, and it contradicts the Big Bang Theory
C. Brønsted–Lowry principle, and it supports the Big Bang Theory
D. Brønsted–Lowry principle, and it contradicts the Big Bang Theory

Numerical Response

7. When light strikes the diffraction grating of a spectroscope, it slows slightly. What is the speed of a wave that has a frequency of 4.22×10^{14} Hz and a wavelength of 6.45×10^{-7} m?

Answer: _____ _____ _____ _____ $\times 10^{8}$ m/s

(Record your answer to **three digits** on the answer sheet.)

30. The ozone layer in the upper stratosphere is beneficial to living organisms because it absorbs

A. radio waves
B. visible radiation
C. ultraviolet radiation
D. microwave radiation

Use the following information to answer the next question.

Net Reaction for the Production of Ground-Level Ozone

$$CO_{(g)} + 2O_{2(g)} \rightarrow CO_{2(g)} + O_{3(g)}$$

31. The main sources of the pollutant responsible for this reaction are

A. wind farms
B. nuclear reactors
C. hydroelectric dams
D. internal combustion engines

Scientists and technologists are working to reduce the amount of pollution produced by the use of technology.

Use the following information to answer the next two questions.

Equations Involving an Energy Change

I $C_{(s)} + O_{2(g)} \rightarrow CO_{2(g)}$

II $^{235}_{92}U + ^{1}_{0}n \rightarrow ^{141}_{56}Ba + ^{92}_{36}Kr + 3^{1}_{0}n$

III $CF_2Cl_{2(g)} \rightarrow CF_2Cl_{2(l)}$

IV $C_8H_{18(l)} + \frac{25}{2} O_{2(g)} \rightarrow 8CO_{2(g)} + 9H_2O_{(g)}$

32. The equation that represents the change that occurs in internal combustion engines is equation

A. I
B. II
C. III
D. IV

33. The equation that represents the change that occurs in some air-conditioning systems is equation

A. I
B. II
C. III
D. IV

34. A chemical plant located between Banff and Calgary produces calcium hydroxide, which is used in smokestacks to remove sulphur dioxide. The removal of $SO_{2(g)}$ by this method is represented by the equation

A. $SO_{2(g)} + CaO_{(s)} \rightarrow Ca(OH)_{2(s)}$

B. $CaO_{(s)} + H_2O_{(l)} \rightarrow Ca(OH)_{2(s)}$

C. $SO_{2(g)} + Ca(OH)_{2(s)} \rightarrow CaSO_{3(s)} + H_2O_{(l)}$

D. $CaCO_{3(s)} + H_2O_{(l)} \rightarrow SO_{2(g)} + Ca(OH)_{2(s)}$

35. Catalytic converters are designed to minimize the release of the main harmful emissions in automobile exhaust: $CO_{(g)}$, unburned gasoline (VOCs), and $NO_{(g)}$. From an environmental point of view, the ideal reaction of $NO_{(g)}$ in a catalytic converter is

A. $2NO_{(g)} \rightarrow N_{2(g)} + O_{2(g)}$

B. $NO_{(g)} + \frac{1}{2}O_{2(g)} \rightarrow NO_{2(g)}$

C. $NO_{(g)} + H_2O_{(l)} \rightarrow HNO_{2(aq)} + \frac{1}{2}H_{2(g)}$

D. $2NO_{(g)} + H_2O_{(l)} + \frac{3}{2}O_{2(g)} \rightarrow 2HNO_{3(aq)}$

Use the following information to answer the next question.

Emissions from automobiles and other sources can react with water to form acids according to these equations.

$$SO_{2(g)} + H_2O_{(l)} \rightarrow H_2SO_{3(aq)}$$
Acid 1

$$SO_{3(g)} + H_2O_{(l)} \rightarrow H_2SO_{4(aq)}$$
Acid 2

$$2NO_{2(g)} + H_2O_{(l)} \rightarrow HNO_{2(aq)} + HNO_{3(aq)}$$
Acid 3 **Acid 4**

Numerical Response

8. The acids numbered above, arranged in order from **strongest to weakest**, are

_____ _____ _____ _____
strongest **weakest**

(Record your **four-digit** answer on the answer sheet.)

36. When compared with a 0.10 mol/L $HNO_{2(aq)}$ solution, a 0.10 mol/L $HNO_{3(aq)}$ solution has a

A. lower pH and lower $[H_3O^+_{(aq)}]$
B. lower pH and higher $[H_3O^+_{(aq)}]$
C. higher pH and lower $[H_3O^+_{(aq)}]$
D. higher pH and higher $[H_3O^+_{(aq)}]$

37. An environmentalist hypothesizes that acid rain has contaminated a lake. She uses both red and blue litmus paper to test the water. Which of the following results may support her hypothesis?

A. Blue litmus paper turns red because the water is basic.
B. Red litmus paper turns blue because the water is basic.
C. Blue litmus paper turns red because the water is acidic.
D. Red litmus paper turns blue because the water is acidic.

38. Material dissolved in water seeps through the soil and enters a lake, causing the lake to become polluted. This process is called

A. erosion
B. leaching
C. oxidation
D. combustion

The technologies used to produce electrical energy are constantly evolving.

39. **Fusion** technology is a new technology. A balanced nuclear **fusion** reaction is represented by the equation

A. $4\,{}^{1}_{1}\mathrm{H} \rightarrow {}^{4}_{2}\mathrm{He} + {}^{0}_{+1}\mathrm{e} + \text{energy}$

B. ${}^{2}_{1}\mathrm{H} + {}^{3}_{1}\mathrm{H} \rightarrow {}^{4}_{2}\mathrm{He} + {}^{1}_{0}\mathrm{n} + \text{energy}$

C. ${}^{230}_{90}\mathrm{Th} \rightarrow {}^{226}_{88}\mathrm{Ra} + {}^{4}_{2}\mathrm{He} + \text{energy}$

D. ${}^{235}_{92}\mathrm{U} + {}^{1}_{0}\mathrm{n} \rightarrow {}^{141}_{56}\mathrm{Ba} + {}^{92}_{36}\mathrm{Kr} + 3\,{}^{1}_{0}\mathrm{n} + \text{energy}$

40. Which of the following conventional power sources produces the greatest amount of greenhouse gases?

A. Fission generators
B. Geothermal generators
C. Combustion generators
D. Hydroelectric generators

Numerical Response

9. Carbon-14 undergoes beta decay according to the equation

$$ {}^{14}_{6}\mathrm{C} \rightarrow {}^{14}_{7}\mathrm{N} + {}^{0}_{-1}\mathrm{e} $$

Calculate the mass that is converted to energy when one mole of Carbon-14 decays.

Answer: _____ _____ • _____ $\times 10^{-7}$ kg

(Record your answer to **two digits** on the answer sheet.)

41. Two energy sources that are considered non-solar in origin are

A. nuclear and wind
B. wind and hydroelectric
C. nuclear and geothermal
D. hydroelectric and geothermal

42. Crops may be grown as a source of biomass fuel. The use of this biomass as an energy source results in no net $CO_{2(g)}$ emission because the

A. combustion of the fuel is complete
B. fuel contains a high proportion of hydrogen
C. carbon dioxide is absorbed in the regrowth of biomass
D. carbon in the fuel is converted to hydrocarbons on burning

Numerical Response

10. A 10.0 A toaster plugged into a 110 V circuit offers _____ _____ _•_ _____ Ω of resistance.

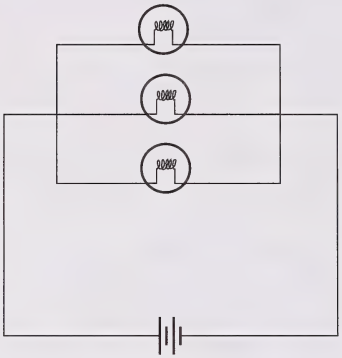
(Record your answer to **three digits** on the answer sheet.)

43. The outlets in household circuits are wired in parallel. A 110 V kitchen circuit operates a 10.0 A toaster and a 5.0 A coffee maker. The total current in this circuit is

A. 0.3 A
B. 2.0 A
C. 15.0 A
D. 50.0 A

Use the following information to answer the next two questions.

Farmyard Light Circuit



Numerical Response

11. A farmyard is illuminated by three identical lights wired as shown above. The total resistance of the three lights is 40.0 Ω, and the total current in the circuit is 4.00 A. The power consumed by the lights is _____ _____ _____ W.

(Record your answer to **three digits** on the answer sheet.)

44. The current in **one** of the lights is

A. 1.33 A
B. 4.00 A
C. 12.0 W
D. 213 W

Numerical Response

12. A power line carried 500 000 V of electricity. A transformer required to step the power down to 35 000 V for distribution has 119 windings on the secondary side. The number of windings on the primary side is _____ _____ _____ _____.

(Record your answer to **four digits** on the answer sheet.)

Written Response – 15%

1. Replacement bulbs for halogen desk lamps are accompanied by the following caution:

CAUTION: *To avoid exposure to ultraviolet radiation, use only in equipment that specifies this lamp and that provides a protective shield of tempered glass.*

The following experiment was used to test the effect of ultraviolet radiation on living cells.

Two groups of petri dishes with a known number of bacterial cells on each plate were exposed to light from a halogen desk lamp. Plates for group A were exposed to light from the lamp with a properly installed tempered-glass shield. Plates from group B were exposed to light from the lamp without a tempered-glass shield in place.

Plates from each group were exposed for either 0, 10, 20, 30, 40, 50, or 60 minutes and then left for 24 hours. After 24 hours, the number of living cells on each plate was counted.

a. i. State an appropriate hypothesis for this investigation.

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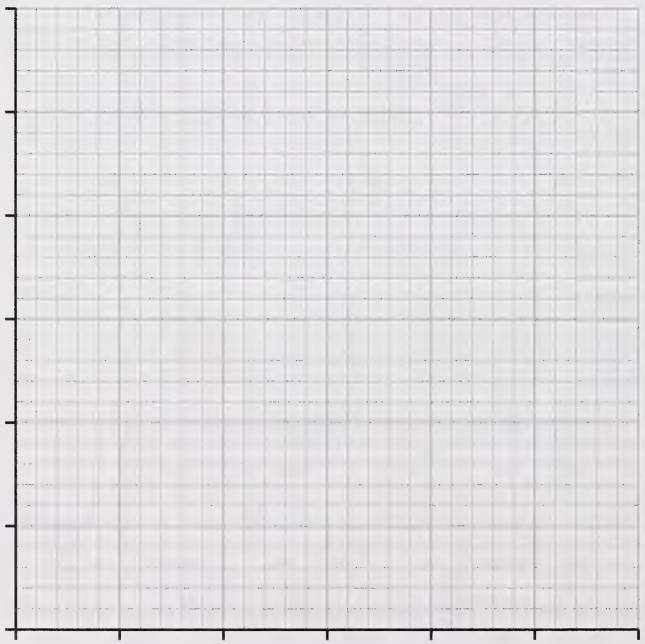
ii. Graph the group A and group B results contained in **Data Table 1**.

Data Table 1

Time (min) of Exposure	Percentage of Cells Living	
	Group A	Group B
0	100	100
10	100	90
20	100	75
30	100	60
40	100	45
50	100	35
60	100	25



iii. State one interpretation that could be made from these data.

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b. Describe the role of ozone in protecting life on Earth from ultraviolet radiation. Outline the environmental issues associated with ozone. Describe the steps society is taking to address these issues.

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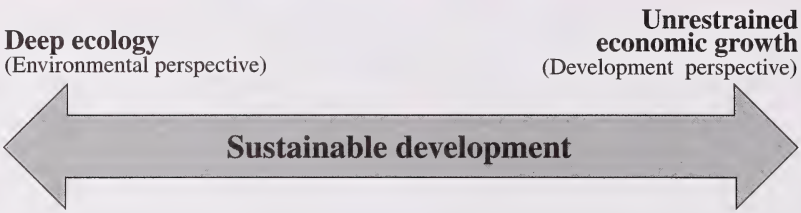
Continue your answer on the next page.

Turn the page to begin the next question.

Use the following information to answer the next question.

Continuum of Deep Ecology to Unrestrained Economic Growth



The term "sustainable development" is commonly used in reference to the relationship between society and the environment. There are approximately 70 other definitions of sustainable development.

One definition of sustainable development: economic growth continues while environmental protection improves.

Written Response – 15%

2. Outline the position of "deep ecology" and contrast it with the position of "unrestrained economic expansion." Explain whether or not it is possible to grow economically while improving environmental protection. Outline the steps you think that society must take to conserve the environment. Your answer should include specific examples of science and technology and their effects on sustainable development. Is it possible that some scientific and technological developments may produce economic benefits while also preserving the environment?

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You have now completed the examination.
If you have time, you may wish to check your answers.

No marks will be given for work done on this page

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No marks will be given for work done on this page

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Science 30
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